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(54) Motor vehicle axle casings

(57) An axle casing is formed from a unitary workpiece (1) and has a central portion (7) from which casing tubes (9) extend. The casing tubes are shaped to a varying cross-section by alternate reduction and ironing steps by means of external dies (3) and internal drawing discs (5). The central portion (7) can be pressed flat and provided with a spherical section opposite an aperture to accommodate a driving mechanism. The axle casing is thereby formed with a uniform strength and is light weight.

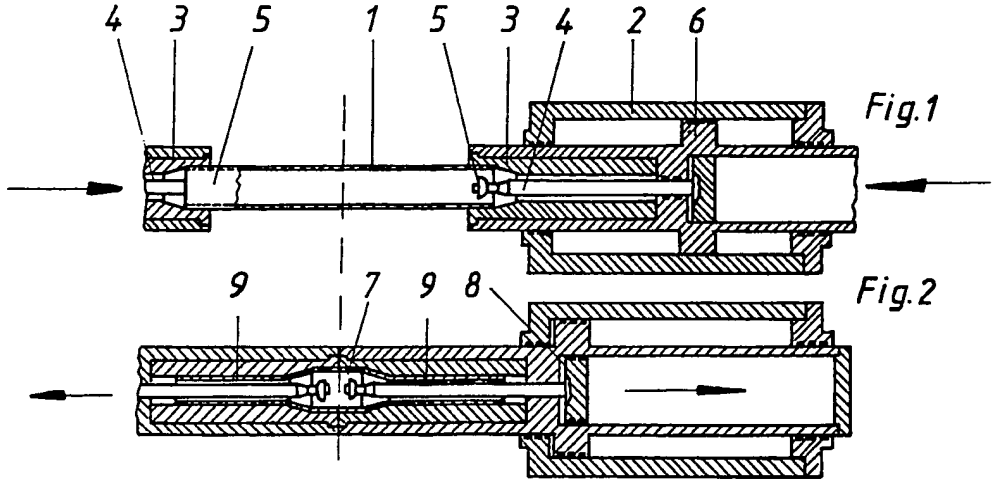

Fig.1

Fig.2

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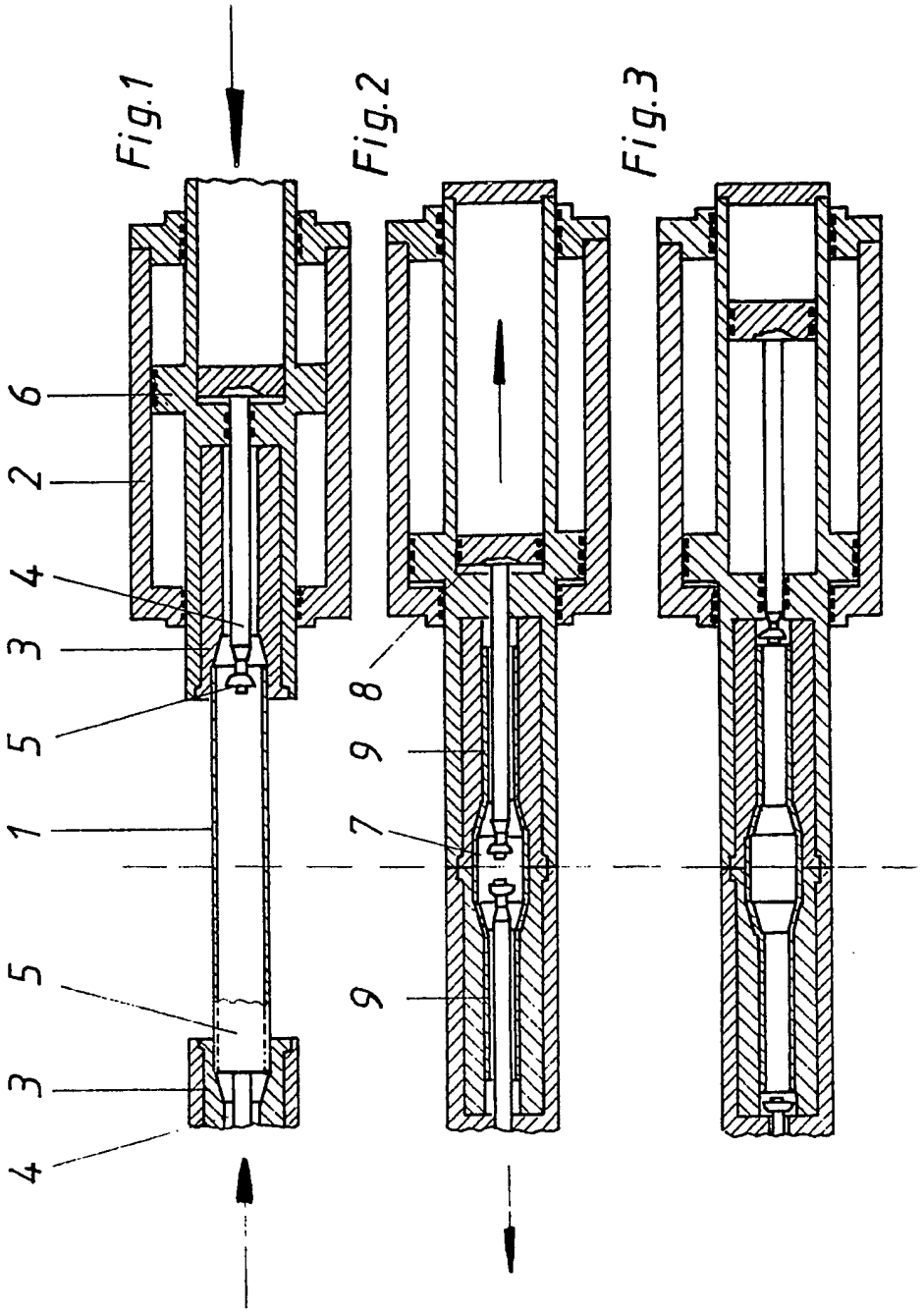


Fig.1
Fig.2
Fig.3
6
2
4
3
5
1
5
3
4
8
9
7
9

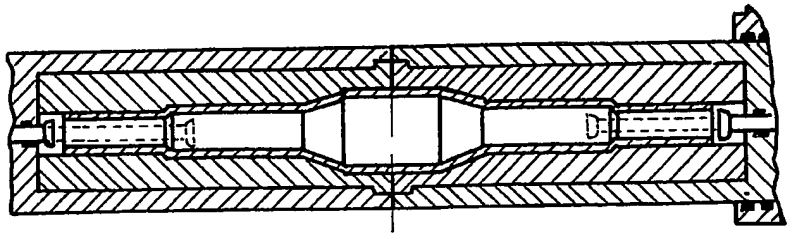


Fig.4

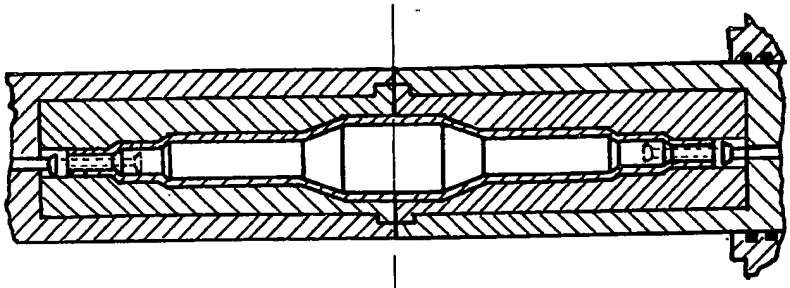


Fig.5

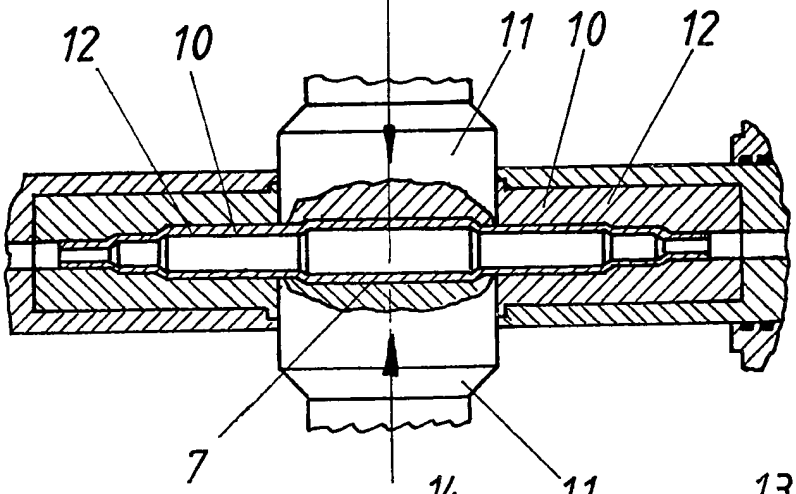


Fig.6

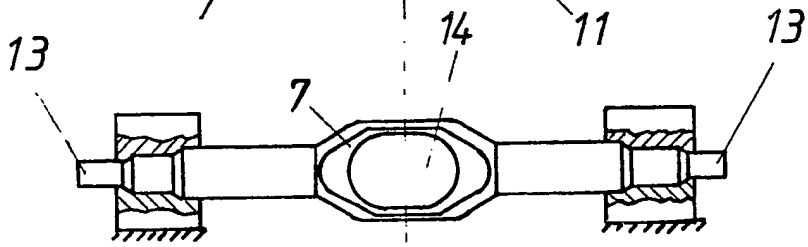


Fig.7

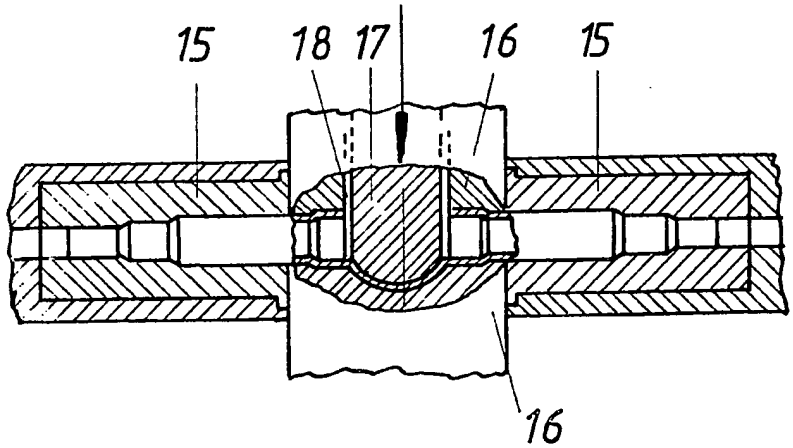


Fig.8

Fig.9

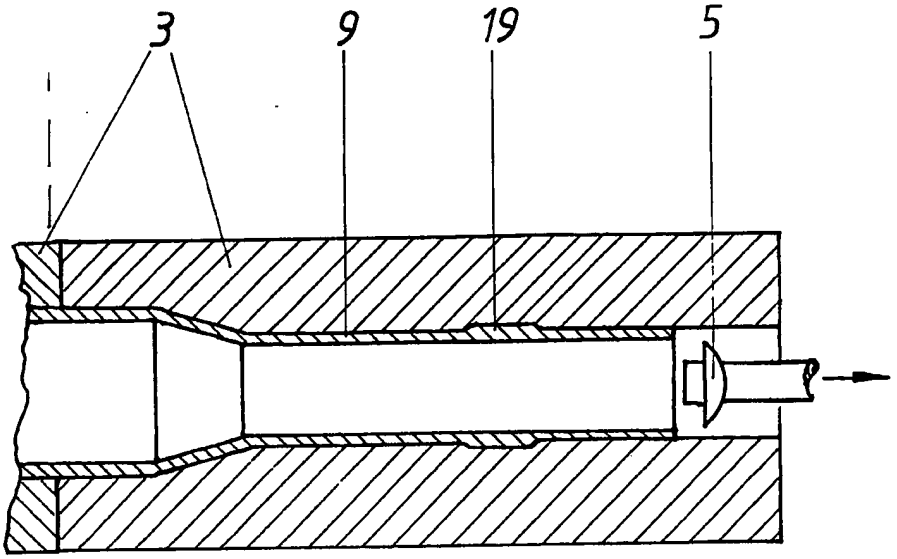


Fig.10

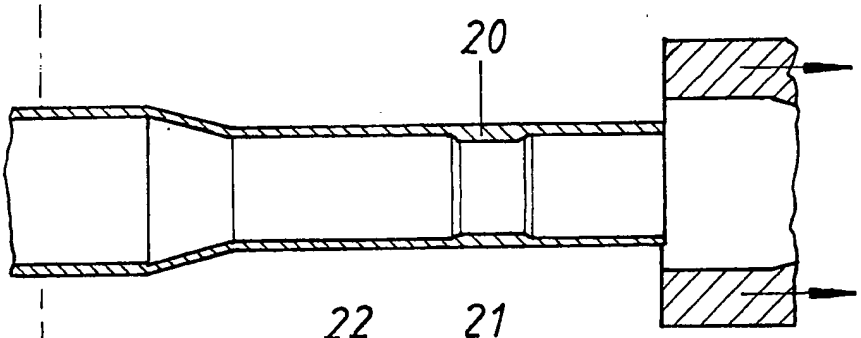
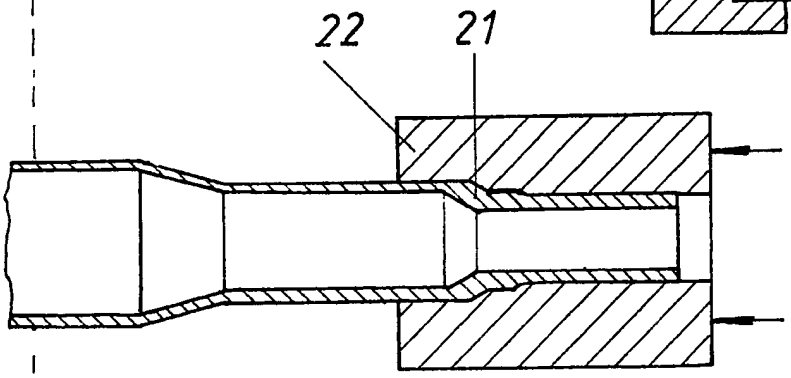


Fig.11



SPECIFICATION

Motor vehicle axl casings

The present invention relates to a hollow axl casing for motor vehicles, and to a process for its manufacture.

Axle casings in a one-piece cast construction are known, more particularly for commercial vehicles. With the light construction required, manufacture is full of risks, and the need for repair welding cannot be ruled out. Axle casings are also known having a central portion for accommodating a drive mechanism including a differential gear unit. Such casings can be made of cast steel and fitted with axle casing tubes. The connection of the gear housing and casing tubes is expensive and difficult if a sound construction is to be assured.

Axle casings can also be welded from pressed metal shells. Bearing in mind the load conditions, disadvantages include the restricted possibilities of adaptation with a view to obtaining a suitable cross-section shape. This can result in poor distribution of material, such as over-dimensioned material cross-sections in secondary-loaded zones, and/or the need for additional reinforcements in highly loaded regions.

Methods are also in use for the production of axle casings which are made from cold-extruded axle halves welded together. This procedure does in fact allow of shaping the cross-section in a way relatively well adaptable to load circumstances, from the process point of view, but conflicts with the aim of minimising weight, and more particularly the eccentricity resulting from manufacture conditions has to be compensated by appropriate additions of material, having regard to minimum wall thicknesses.

Finally, methods are known which aim at achieving a desirable axle casing on the basis of explosive forming or hydraulic recessing, for example as shown in published German Application No: 19 08 729, but these methods involve technical difficulties for which hitherto no practicable solutions have been found.

For the above and other reasons, the production of a one-piece axle casing with varying cross-sectional forms has not yet been successfully carried out in large-scale industry.

The present invention seeks to provide a motor vehicle axle casing with varying cross-section forms and unbroken fibre, and which is of light weight. An axle casing in accordance with the invention comprises a unitary hollow body having a central portion and casing tubes extending on either side therefrom, the casing tubes connecting seamlessly with the central portion and each having varying wall thickness and cross-section along its length. Normally, each casing tub comprises a plurality of tubular portions of different cross-sections, wherein the wall thickness in the transitional regions between tubular portions is greater than the wall thickness in said portions.

The invention also provides a process for the manufacture of a motor vehicle axle casing having a varying cross-section, from a one-piece tubular workpiece, which process comprises reducing the external dimensions of a portion of the workpiece in stages from its ends inwards and, after each reducing stage, ironing the internal surface of the reduced portion outwardly from its inner end; pressing a central portion of the workpiece flat and providing at least one aperture therein; and forming a spherical section in the central portion opposite said aperture. A drawing disc is normally used in each ironing step and the operation of the respective drawing disc is controlled to produce different wall thicknesses in different portions of the workpiece, preferably to produce thickened wall portions in the transitional regions between portions of the workpiece having different external dimensions.

The one-piece axle casings produced with the method of the present invention from a starting piece consisting of a hollow body, have a number of advantages over hitherto known constructional forms; namely, unbroken fibre, narrow tolerances and little weight fluctuations, and these characteristics can be duplicated in continuous production.

The invention will now be described by way of example and with reference to the accompanying diagrammatic drawings in which:—

Figures 1 to 3 show the production steps of the first shaping stage;

Figures 4 and 5 show continuing production stage, in each case in the end phase of shaping;

Figure 6 shows the deforming process of the central housing portion in vertical sectional view;

Figure 7 shows the externally trimmed axle casing with a housing aperture arranged therein;

Figure 8 shows the deformation of the central housing portion by a pressure ram;

Figure 9 shows the pair of dies with a formed outer ridge, with the action of the drawing disc;

Figure 10 shows an inner ridge produced by reduction; and

Figure 11 shows the thickened cross-section transition under the action of the reducing die of the following processing stage.

In Fig. 1 a cylindrical starting tube 1 is put into the dies 3 which are connected to a double-acting hydraulic apparatus 2. The operation of the dies 3 is effected by hydraulic pistons 6. The dies 3 are hollow and accommodat piston rods 4 with drawing discs 5. The piston rods 4 are operated by means of

pistons 20. The central portion 7 remaining after th narrowing of the ends of the hollow body 1 is, as Fig. 6 shows, pressed flat with the use of a pair of female dies 11, the workpiece being held by means of its shaped casing tubes 12 by the dies 10.

To produce an axle casing, the cylindrical starting tube 1 is held by a symmetrically double-acting hydraulic apparatus 2 through the agency of a pair of dies 3 (Fig. 1). Paired drawing mandrels 4 are fitted with drawing discs 5. At the first deforming step of the first shaping stage the reducing tools 3 by moving towards one another bring about a reduction of the starting tube 1 from its ends inwards, pressure being made to act on the hydraulic pistons 6. In this way the central housing portion 7 shown in Fig. 2 is left.

In the first movement (Fig. 2) the drawing discs 5 advanced into the interior of the housing portion 7.

In the second deformed step of the first shaping stage, there now takes place, with the movement of the hydraulic piston 8 in the arrowed direction, the ironing of the casing tubes 9 previously reduced in diameter, by the drawing discs 5.

Fig. 3 shows this second deforming step in the end position of the first shaping stage.

Figs. 4 and 5 show the cross-section reduced in two further stages.

As Fig. 6 shows, the dies 10 fix the shaped axle casing tubes 12 so that the pair of female dies 11 can press the housing portion 7 flat. The fourth shaping stage is thus ended.

In the fifth shaping stage the trimming of the axle casing tube ends 13 is carried out, likewise opening the housing portion 7 at one side with an aperture 14.

Fig. 8 shows the sixth shaping stage in the end phase. Here the die pairs 15 and 16 enclose the now shaped axle casing body all round, so that the ram 17 in association with the work holder 18 through the aperture 14 expands the housing portion 7 in the shape illustrated.

In Fig. 9 the pair of dies 3 is shown together with an outer ridge 19 which has been formed, under the influence of the drawing disc 5. Fig. 10 shows the inner ridge 20 produced by reduction, and Fig. 11 shows the thickened cross-section transition 21 under the influence of the reducing die 22 of the following processing stage.

CLAIMS

1. A process for the manufacture of a motor vehicle axle casing having a varying cross-section, from a one-piece tubular workpiece, which process comprises reducing the external dim nsions of a portion of the workpiec in stages from its ends inwards and, after each reducing stage, ironing the internal surface of the reduced portion outwardly from its inner end; pressing a central portion of the workpiece flat and providing at least one aperture therein; and forming a spherical secti n in the central portion opposite said aperture.

2. A process according to Claim 1 wherein a drawing disc is used in each ironing step, and wherein the aperture of the respective drawing disc is controlled to produce different wall thicknesses in different portions of the workpiece.

3. A process according to Claim 2 wherein the drawing discs are operated to produce thickened wall portions in the transitional regions between portions of the workpiece having different external dimensions.

4. A process according to any preceding Claim including additional shaping steps in which the central portion is deformed to a larger cross-section.

5. A process for the manufacture of a motor vehicle axle casing substantially as described herein with reference to the acompanying drawings.

6. A motor vehicle axle casing comprising a unitary hollow body having a central portion and casing tubes extending on either side therefrom, the casing tubes connecting seamlessly with the central portion and each having varying wall thickness and cross-section along its length.

7. An axle casing according to Claim 6 wherein each casing tube comprises a plurality of tubular portions having different cross-sections, and wherein the wall thickness in the transitional regions between tubular portions is greater than the wall thickness in said portions.

8. A motor vehicle axle casing substantially as described herein with reference to the accompanying drawings.

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